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NATURAL PLANT COMMUNITIES OF BERKSHIRE COUNTY, MASSACHUSETTS[1]

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ABSTRACT

The natural plant communities and habitats of Berkshire County, Massachusetts, are described. Communities are delineated by a description of the physical characteristics of the habitat and typical vegetation. An extensive list of species most closely associated with each community is provided. Distribution of the communities within the county is discussed, and examples are given. Other factors, both biotic and abiotic, that influence development of each community are noted.

Key Words: Natural plant communities, habitats, Berkshire County, Massachusetts

INTRODUCTION

Berkshire County covers 260,860 ha and is located at the western end of Massachusetts. Varied topography and bedrock have resulted in diverse habitats that support a flora of 1777 taxa (Weatherbee, 1990), both native and introduced, including 117 state-listed rare taxa (Sorrie, 1989; they are indicated by an asterisk in this discussion).

The plant communities described below for Berkshire County are based in large part on Rawinski's (1983) outline of a classification of natural communities in New England. In his classification, the communities are described by a brief description of physical characteristics of the habitat and physiognomy of the community, and are identified by a few of the most characteristic plant and animal species. Although less detailed, his descriptions of communities are similar in scope to that of Reschke (1980) for adjacent New York State, but we found Rawinski's classification more applicable to New England.

For this study, information on species composition was derived from extensive field notes of the senior author made during the preparation of a Flora of Berkshire County (Weatherbee, 1990), from notes made by Bruce Sorrie, former Massachusetts Natural Heritage and Endangered Species Program Botanist, and from theses and published studies conducted in Berkshire County. Us-

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ing this information, the authors were able to provide a much more detailed account of the vascular plant species that are characteristic of each community than that given by Rawinski (1983), and to describe the structure of those communities in Berkshire County.

The most important factors determining habitat and plant community relate to bedrock geology (Figure 1) and to the impact of glaciation, climate, and plant migration. Geologic events have influenced the development of soil, topographic relief, drainage patterns, and elevation (Figure 2). Bedrock described as calcareous includes the Stockbridge Formation, which consists of various types of marble, and the Walloomsac Formation which consists of calcitic and schistose marble (Zen, 1983). Regional climate determines the overall type of vegetation, but there is some variation in climate within the county due to elevational variation (176 m to 1064 m) and microclimatological differences produced by local topographical diversity. Post-glacial migration of species from various refugia south of the glacial margin or from the exposed coastal plain has played an important role in determining the pool of species which ultimately colonized available habitats and developed our plant communities.

The following 35 natural plant communities are recognized by us for Berkshire County:

Forests and Woodlands

- Mesic Northern Conifer Forest
- Mesic Northern Hardwood Forest
- Rich Mesic Forest
- Mesic Acidic Oak/Conifer Forest
- Dry Acidic Oak/Conifer Forest
- Dry Calcareous Oak/Conifer Forest
- Floodplain Forest
- Pitch Pine/Scrub Oak Barrens

Rocky Summit and Cliff Communities

- Southern Acidic Rocky Summit
- Southern Calcareous Rocky Summit
- Southern Acidic Cliff
- Southern Calcareous Cliff
- Serpentine Outcrop

Figure 1. Bedrock geologic map of Berkshire County (redrawn from Zen, 1983).

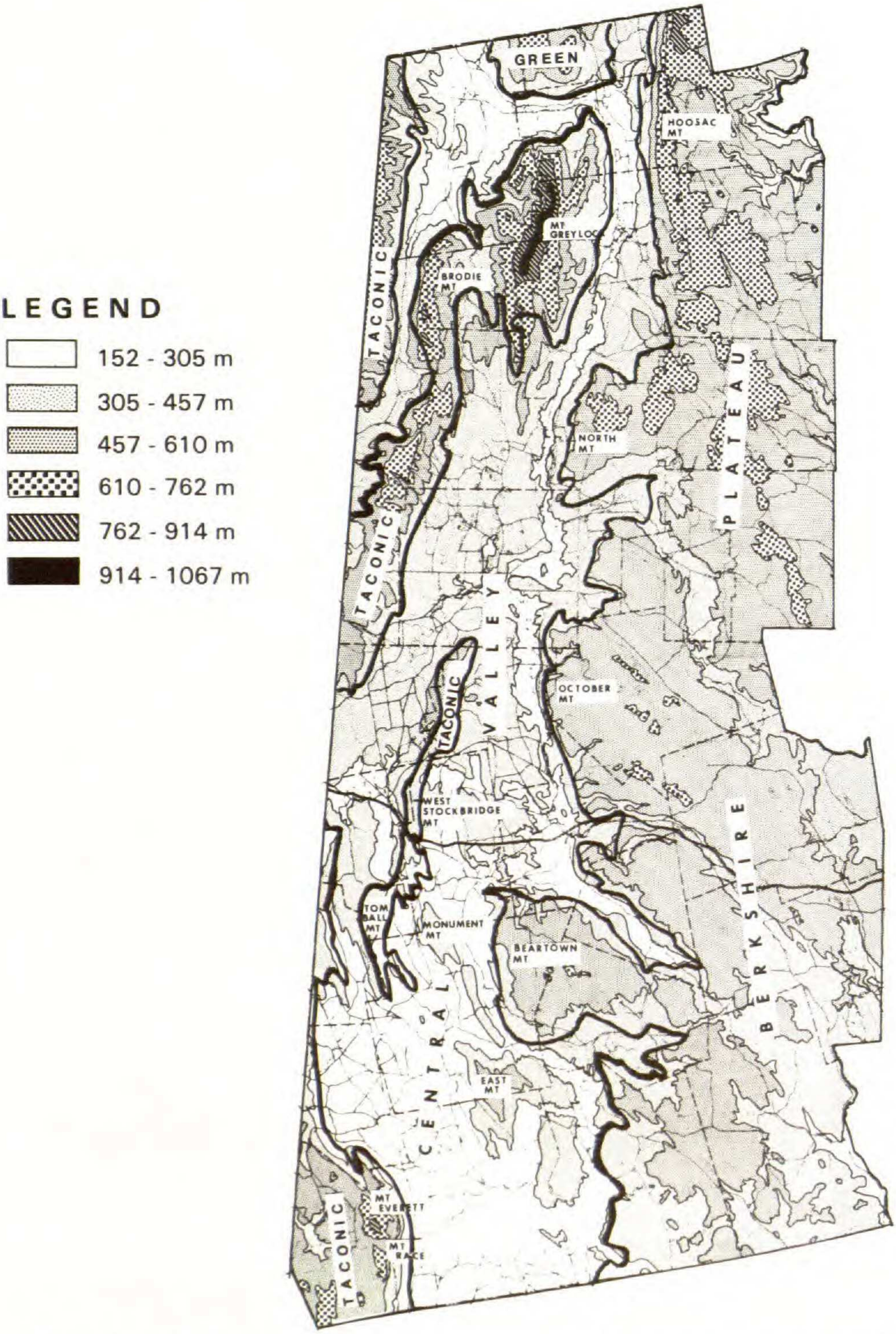

Figure 2. Topography and physiographic regions of Berkshire County (adapted from Technical Planning Associates, 1959).

Lakes and Ponds

- Clear Softwater Lake/Pond
- Acidic Brownwater Lake/Pond
- Moderately Alkaline Lake/Pond
- Highly Alkaline Lake/Pond

Rivers, Streams and Springs

- High Gradient Stream
- Medium Gradient Stream
- Low Gradient Stream
- Spring and Spring Run

Wetlands

- Acidic Conifer Swamp
- Acidic Hardwood Swamp
- Circumneutral Hardwood Swamp
- Acidic Shrub Swamp
- Circumneutral Shrub Swamp
- Robust Emergent Marsh
- Acidic Graminoid Marsh
- Circumneutral Graminoid Marsh
- Level Bog
- Forested Fen
- Shrub Fen
- Sloping Graminoid Fen
- Lake Basin Graminoid Fen
- Calcareous Seep

FORESTS AND WOODLANDS

Mesic Northern Conifer Forest Community

The montane spruce-fir forest (Oosting and Billings, 1951; Cogbill, 1987), the boreal forest (Siccama, 1974) or the Northeastern Spruce-Fir Forest of Küchler (1964) are alternate terms for this community dominated by *Picea rubens* and *Abies balsamea.* It is best developed above 914 m on Mt. Greylock summit and along the adjacent ridge of Saddle Ball where these two species occur with *Betula cordifolia* and *B. alleghaniensis.* The summit, although drastically altered now, was described in 1799 as being densely covered with stunted *Abies balsamea* (Dwight, 1822). Other associated species are *Sorbus americana, S. decora**, *Luzula parviflora* ssp. *melanocarpa**, *Amelanchier bartramiana**, *Gaultheria hispidula, Solidago macrophylla**, *Viburnum lantanoides, Ribes glandulosum, Oxalis acetosella, Cornus canadensis, Dryopteris intermedia, D. campyloptera* and *Lycopodium lucidulum.*

Many needle-leaved evergreen trees are well adapted to high elevations where a shorter frost-free season, colder average temperatures, high winds, heavy snow, lower light level and formation of rime ice due to frequent cloud cover, and shallow soil create difficult growing conditions (Marchand, 1987). In the spruce-fir zone of the Green Mountains, Siccama (1974) noted that the number of frost-free days was 93. He suggested that the elevational limit of low-hanging clouds corresponds to the elevation of the transition zone between the montane boreal forest and the northern hardwoods zone. *Abies balsamea* trees on the summit of Mt. Greylock exhibit a "table tree" form, as described by Marchand (1987). Ice particles, wind-driven over the surface of the snow, remove foliage above the snow while branches below the snow remain luxuriant.

Mesic Northern Hardwood Forest Community

This widespread community covers the slopes and summits of all but the highest mountains and also the low hills and valley sides of the northern half of the county. Within the broader boundary of this community, other communities occur locally on edaphically, topographically or climatically distinct areas. The upper elevational limit of this forest ranges from 800–850 m, which closely agrees with Siccama's (1974) estimate for this community type in northern Vermont of 792 m. Towards the southern part of the county, particularly in the valley region, this forest type grades into the Mesic Acidic Oak/Conifer Forest.

The co-dominant tree species *Acer saccharum, Fagus grandifolia* and *Betula alleghaniensis* occur in varying proportions throughout the community, with *B. alleghaniensis* becoming dominant at higher altitudes. Other trees that commonly occur are *Fraxinus americana, Betula lenta, B. papyrifera, Quercus ru-*

bra, Prunus serotina and *Acer rubrum.* Except for *Fraxinus americana,* these species may indicate a past history of disturbance, both natural and human. *Quercus rubra,* although often an important component of the mature forest, does not regenerate well in shade. Very large individuals of *Q. rubra* have been observed on some slopes of Mt. Greylock, but the regeneration around the trees is all *Acer saccharum. Tsuga canadensis* is seen in small patches in moist ravines with thin soils, steep rocky, north-facing slopes and along moist streambanks. The Mesic Northern Hardwood Forest becomes more common on the Berkshire Plateau; there it becomes intermixed with *Picea rubens* and *Abies balsamea.*

Acer pensylvanicum, A. spicatum, Ostrya virginiana, and *Hamamelis virginiana,* which are adapted to growing under the closed canopy, form a characteristic understory layer. Typical shrubs include *Taxus canadensis, Viburnum lantanoides, V. acerifolium, Sambucus pubens* and *Lonicera canadensis.* The vernal flora is somewhat sparse, but *Claytonia caroliniana, Erythronium americanum, Viola rotundifolium* and *Trillium erectum* are common in the community. The ground cover includes *Lycopodium* spp., *Mitchella repens, Aster acuminatus, A. divaricatus* and the ferns *Dryopteris intermedia* and *Polystichum acrostichoides.*

Factors that influence the extent of this forest are climate and soil. Siccama (1974) found the frost-free season in the Green Mountain northern hardwoods forest to average about 144 days, 51 days longer than in the montane boreal forest. Generally the soil is well-drained, but moist throughout the year, and most often derived from a bedrock of schist (Figure 1), and less often from gneiss or quartzite. In studies of the forests of New Hampshire, Leak (1978) found typical northern hardwoods occurred on fine glacial till. Kudish (1979) indicated that *Acer saccharum* and other deciduous trees need at least a 30–90 cm layer of till to grow well, while conifers can survive on only 8–15 cm of till. His studies in the Catskills showed that till depth was more limiting than pH or elevation. This factor appears to be important in the distribution of this forest community in Berkshire County. High elevation (Siccama, 1974) with its concomitant cloud cover and shorter growing season seems to be the most important factor in limiting development of this community type on mountain slopes. Drier soils may account for the community's decreasing abundance in the southern section of the county.

Rich Mesic Forest Community

Occurring in smaller, discontinuous areas throughout the county and typically surrounded by other forest community types, sites of the Rich Mesic Forest correlate with, and are influenced by, calcareous bedrock (Figure 1) and associated alkaline groundwater. The best examples of this community are situated on slopes below calcareous outcrops, on talus below these outcrops or on fairly level sites where bedrock is near the surface. These sites tend to be on the low hills edging valleys, but they also occur higher (822 m) on the slopes of Mt. Graylock.

The community is distinguished by a dominance of *Acer saccharum* in most examples, sometimes to the near exclusion of other tree species. Other trees, in order of decreasing closeness of association with the community, are *Fraxinus americana, Tilia americana, Carya cordiformis, Betula lenta, B. alleghaniensis* and *Fagus grandifolia.* Leak (1978) found that in the White Mountains of New Hampshire, *Acer saccharum* became dominant only on enriched sites, and that *Fraxinus americana* was abundant only on these sites. Individuals of *Quercus rubra* may attain large stature and remain part of this community for a long time, but the species does not regenerate well. *Dirca palustris,* a shrub, is restricted to this habitat, and is thus an important indicator species. Additionally, *Ostrya virginiana,* an understory tree, is abundant in these rich sites.

In the Rich Mesic Forest the herbaceous species are abundant and diverse, and the community has an especially rich vernal flora. Table 1 lists these species in approximate order of decreasing degree of association with the community.

The most important determining factors in this community are the presence of calcareous rock and adequate moisture. The soil is derived from the soft, easily weathered rock. The higher pH of the soil facilitates microbial activity and decomposition of litter. Leaves of *Acer saccharum* are rich in bases (Dickinson and Pugh, 1974), thus favoring rapid decomposition and recycling of nutrients. An adequate supply of moisture is also crucial to this process and to development of mull soils typical of this community (Bormann and Buell, 1964). The litter layer is thinner than that of Northern Hardwood Forest because of rapid turnover, thus enabling the small vernal species to receive enough sunlight to emerge

Table 1. Herbs of the Rich Mesic Forest, listed in approximate order of decreasing degree of association with the community. * = State-listed rare species.

Caulophyllum thalictroides (L.) Michx.
Adiantum pedatum L. var. *pedatum*
Hepatica acutiloba DC.
Allium tricoccum Ait.
Asarum canadense L. var. *canadense*
Dentaria diphylla Michx.
Dentaria laciniata Muhl. ex Willd.
Dicentra canadensis (Goldie) Walp.
Dicentra cucullaria (L.) Bernh.
Uvularia grandiflora Sm.
Dryopteris goldiana (Hook. ex Goldie) Gray
Diplazium pycnocarpon (Spreng) Brown
Hydrophyllum virginianum L.
Carex plantaginea Lam.
**Carex hitchcockiana* Dewey
Viola rostrata Pursh
Viola selkirkii Pursh ex Goldie
Galearis spectabilis (L.) Raf.
Cypripedium calceolus L. var. *pubescens* (Willd.) Correll
**Milium effusum* L.
**Blephilia hirsuta* (Pursh) Benth. var. *hirsuta*
**Panax quinquefolius* L.
Oryzopsis racemosa (Sm.) Ricker
Hystrix patula Moench var. *patula*
Carex deweyana Schwein. var. *deweyana*
Carex amphibola Steud. var. *rigida* (Bailey) Fern.
Carex rosea Schkuhr ex Willd.
Sanicula trifoliata Bickn.
**Sanicula gregaria* Bickn.
**Waldsteinia fragarioides* (Michx.) Tratt.
Thalictrum dioicum L.
Thalictrum (Anemonella) thalictroides (L.) Eames & Boivin
Ranunculus abortivus L.
**Hydrophyllum canadense* L.
Botrychium virginianum (L.) Sw.
Viola canadensis L.
Solidago flexicaulis L.
Carex hirtifolia Mackenzie
Sanguinaria canadensis L.
Actaea pachypoda Ell.
Actaea rubra (Ait.) Willd.
Laportea canadensis L.
Osmorhiza claytonii (Michx.) Clarke

early enough in the spring to complete their life cycles before the canopy leafs out.

Mesic Acidic Oak/Conifer Forest Community

This community is found in the southern half of the county and the southern third of the Berkshire Plateau (Egler, 1940) usually in rocky, acidic soil. This community is more difficult to define. It grades into the Mesic Northern Hardwood and Dry Acidic Oak/Conifer Forests, and in some areas may represent a stage rebounding from earlier disturbance (McVaugh, 1958). Küchler's (1964) designation of this area as transitional between Mesic Northern Hardwood and Appalachian Oak, indicates the variability of this community. Westveld et al. (1956) used the term Transition Hardwoods to indicate the overlap of northern hardwoods with oaks and hickories.

Quercus rubra, Acer rubrum and *Pinus strobus* share dominance, but *Tsuga canadensis* and *Fagus grandifolia* are important, and may become more dominant as the forest matures, as Egler (1940) describes for the southern section of the Berkshire Plateau. *Prunus serotina, Betula lenta* and *B. papyrifera* are common. Understory trees and shrubs include *Acer pensylvanicum, Kalmia latifolia, Amelanchier arborea, Hamamelis virginiana,* and *Viburnum acerifolium.* The ground cover layer is often somewhat sparse, but typical species include *Lycopodium obscurum, Polystichum acrostichoides, Medeola virginiana, Maianthemum canadense, Aster divaricatus, Polygonum cilinode, Aralia nudicaulis,* and *Carex pensylvanica.* Soil derived from acidic bedrock, such as quartzite or gneiss (Figure 1), tends to be rocky, shallow, well-drained and poor in nutrients. These soil characteristics seem to be important in the distribution of this community. Kudish (1979) states that the tree species characteristic of this community can subsist on minimum till depths of 20–45 cm. Leaves of *Quercus rubra* do not decompose quickly, resulting in the development of a thick litter layer; they also contribute to the development of acidic soil. The same is true of the needles of *Pinus strobus* and *Tsuga canadensis* (Dickinson and Pugh, 1974). Acidic, shallow soil is not favorable for growth of *Acer saccharum,* thus this species is often absent. *Betula alleghaniensis* is often scarce as well. Since the canopy of *Quercus rubra* is more open than a canopy of *Acer saccharum,* the light levels that reach the forest floor favor reproduction of *Quercus rubra* and *Acer rubrum,* species that require higher light levels for seedling growth.

Dry Acidic Oak/Conifer Forest Community

This community, dominated by species of *Quercus,* occurs on soils derived from acidic rock, typically from quartzite (Figure 1), on upper slopes where the soil is thin and excessively well-drained. Sites occur throughout the Berkshires, particularly on south-facing slopes, but the community is more common in the southern half of the county.

Quercus prinus, along with *Q. velutina, Q. alba* and *Pinus rigida,* are the typical tree species, but *Pinus strobus, Betula papyrifera, Acer rubrum* and *B. lenta* are also very common. *Castanea dentata* is frequently present, and may attain small tree size before succumbing to Chestnut blight. *Carya glabra* occurs most commonly in southernmost towns, and *Sassafras albidum* may be locally common. The canopy is quite open, and ericaceous shrubs, such as *Vaccinium angustifolium, V. pallida, Gaylussacia baccata, Rhododendron prinophyllum* and *Kalmia angustifolia* form a dense shrub layer. *Gaultheria procumbens* and *Epigaea repens* are common evergreen ground cover species in more open areas. Herbaceous species are few and are represented by *Pteridium aquilinum, Melampyrum lineare, Cypripedium acaule, Lysimachia quadrifolia* and, uncommonly, *Isotria verticillata.*

The thin, dry soil that develops over acidic bedrock with many fractures and joints providing drainage, is an important factor in the distribution of this community. Because decomposition of litter and development of soil is slow in acidic sites (Dickinson and Pugh, 1974), these soils tend to be thin and infertile (McIntosh, 1959). The openness of the forest canopy, coupled with an often south-facing slope, allows high insolation of the soil, which results in increased dryness and higher soil temperatures (Cantlon, 1953). Succession to a more mesic and closed-canopy forest may occur (Little, 1973), but this process may easily be set back by the occurrence of an occasional fire, to which this community is particularly susceptible. Fire, which reduces ground cover and stimulates the opening of serotinous cones (Elias, 1987), is important to the regeneration of *Pinus rigida.* This community shares many species with, and gradually grades into, the Southern

Acidic Rocky Summit Community, a community that usually occupies the ridges above this community.

Dry Calcareous Oak/Conifer Forest Community

This community, occupying well-drained slopes or low ridges underlain with calcareous rock (Figure 1), occurs more commonly in the southern half of the county. In the north, it is found occasionally on south- or southwest-facing slopes, but lacks some of the characteristic species of the community type as it occurs in the southernmost towns. These more southerly species are designated by a plus sign (+) in the following discussion.

Quercus alba, Q. velutina and *Q. muhlenbergii**+ are characteristic of this community, along with *Carya ovata* and *Ostrya virginiana. Pinus strobus* and *Quercus rubra* occur commonly, although scattered. The understory trees *Cornus florida* and *Staphylea trifolia*+, flourish under this more open canopy. *Carya ovata* and *Ostrya virginiana* often form a distinct association, with which two rare grasses occur: *Poa languida** and *Sphenopholis nitida**. The community is rich in herbaceous species, which are listed in Table 2 in approximate order of decreasing degree of association with the community.

Bedrock, slope and aspect play an important part in the composition of this community. The soil, a fine sandy or clayey loam, is strongly influenced by the calcareous bedrock, which may be near the soil surface, or may occur as an outcrop. In contrast to the Rich Mesic Forest, there is no seepage of groundwater. A topographical barrier, a ridge of 426 m elevation, rises north of Lanesborough, and may have prevented those species common in the southern part of the county from spreading to northern sites, in addition, there is little suitable habitat. The high number of herbaceous species may relate to the less dense *Quercus* spp. canopy and high soil fertility derived from calcareous bedrock.

Floodplain Forest Community

This well-defined community occurs on deep, alluvial soil bordering the low-gradient sections of the major rivers: the Housatonic, Hoosic, Green (in Great Barrington), Williams, Konkapot and Deerfield Rivers. The community which experiences periodic flooding, most frequently in the spring, may occur as a narrow

Table 2. Herbs of the Dry Calcareous Oak/Conifer Forest, listed in approximate order of decreasing degree of association with the community. + = Species restricted to southern-most towns. * = State-listed rare species.

Asclepias quadrifolia Jacq.
Arabis canadensis L.
+*Lespedeza violacea* (L.) Pers.
Lespedeza intermedia (S. Wats.) Britt.
Rosa carolina L.
Aureolaria flava (L.) Farw.
+*Aureolaria virginica* (L.) Pennell
Linum virginianum L.
+*Ranunculus hispidus* Michx. var. *hispidus*
+**Chamaelirium luteum* (L.) Gray
+*Muhlenbergia tenuiflora* (Willd.) BSP.
+*Silene caroliniana* Walt. var. *pensylvanica* (Michx.) Fern.
+*Paronychia canadensis* (L.) Wood
+*Desmodium rotundifolium* DC.
Hieracium venosum var. *nudicaule* (Michx.) Farw.
**Sphenopholis nitida* (Biehl.) Scribn.
**Poa languida* Hitchc.
+*Helianthus divaricatus* L.
Carex eburnea Boott
+*Viola triloba* Schwein. var. *dilatata* (Ell.) Brainerd
Campanula rotundifolia L.
Triosteum aurantiacum Bickn.
Hepatica americana (DC.) Ker.
Ceanothus americanus L.
Desmodium nudiflorum (L.) DC.
Desmodium paniculatum (L.) DC. var. *paniculatum*
Uvularia perfoliata L.

band along the river or as extensive flat areas, and include oxbow ponds and associated marshes. In some areas there is a step-wise series of terraces back from the river, the highest level being the driest. Silt bars and mud banks provide small pioneer habitats, colonized by a few annual species or by seedlings of the Floodplain Forest trees. Many of these rich alluvial habitats have been cleared for agriculture, leaving only a narrow strip, if any, of the original vegetation along the river.

Salix nigra, Platanus occidentalis and *Populus deltoides* are early colonizers of banks and silt bars (Nichols, 1916) and are more often found nearest the river. *Acer negundo* is more common as a floodplain tree along the Hoosic River, while *A. saccharinum* is dominant on floodplains in the Housatonic River watershed. *Acer nigrum** is locally common. *Ulmus americana,* formerly common along floodplains, is now more typically represented by bare, dead trunks than by living trees. *Fraxinus pennsylvanica* is usually found on riverbanks, while *Juglans cinerea, Tilia americana* and *Celtis occidentalis* typically occupy the upper alluvial terraces of the floodplain.

There are few shrubs characteristic of the floodplain; however, introduced *Lonicera morrowii* has become weedy. Several woody vines, *Vitis riparia, Parthenocissus quinquefolia* and *Menispermum canadense,* and the herbaceous vines, *Echinocystis lobata* and *Sicyos angulatus,* flourish on the floodplains.

Many of the herbaceous species (Table 3) occur restricted to floodplain forests or are more commonly associated with this community.

Inundation is the major factor influencing in development of this community. Plants growing in a typical floodplain, which is usually inundated for a significant length of time only during the spring (Nichols, 1916), must be adapted to withstand a reduced oxygen supply to their roots during that time. Likewise, these species must tolerate a high water table most of the year. The impact of inundation may account for the lack of a shrub layer. Ice floes scour banks and silt bars, resulting in many newly disturbed sites, open for colonization. The cutting of a new channel may shift the river, resulting in somewhat isolated floodplain remnants. The environment of a river is one of constant change.

The soil, silt that has been deposited by the river, is typically deep, without distinct horizons and contains considerable organic matter (Rawinski, 1983). The woody species occupying these sites typically grow to a large size, and herbaceous growth can likewise be exceedingly vigorous and tall. Calcareous rock underlies portions of these river valleys, and probably influences the higher fertility of the soil.

Pitch Pine/Scrub Oak Barren Community

This community once occurred extensively on the sandy outwash plains along the Housatonic and Konkapot Rivers in the southernmost towns of Sheffield and New Marlborough. *Pinus rigida* and *Quercus ilicifolia* dominated an open woodland with a dense shrub layer of *Vaccinium angustifolium, V. pallidum* and *Gaylussacia baccata.* Grassy clearings were dominated by *Schizachyrium* (*Andropogon*) *scoparium,* and *Quercus prinoides* oc-

Table 3. Herbs of the Floodplain Forest, listed in approximate order of decreasing degree of association with the community. * = State-listed rare species.

**Arisaema dracontium* (L.) Schott
**Carex davisii* Schwein. & Torr.
**Carex grayi* Carey
**Carex trichocarpa* Schkuhr
**Carex tuckermanii* Dewey
**Carex typhina* Michx.
Polygonatum biflorum (Walt.) Ell. var. *commutatum* (Schultes f.) Morong
Allium canadense L. var. *canadense*
Xanthium strumarium L. var. *canadense* (P. Mill.) Torr. & Gray
Ambrosia trifida L.
Helenium autumnale L. var. *autumnale*
Teucrium canadense L. var. *virginicum* (L.) Eat.
Ribes americanum Mill.
Urtica dioica L. ssp. *dioica*
**Claytonia virginiana* L.
**Carex alopecoidea* Tuckerm.
Rudbeckia laciniata L.
**Aster prenanthoides* Muhl.
Elymus wiegandii Fern.
Elymus riparius Wieg.
**Elymus villosus* Muhl. ex Willd.
Bromus altissimus Pursh
Matteuccia struthiopteris (L.) Todaro
Carex hirtifolia Mackenzie
Geum laciniatum Murr. var. *trichocarpum* Fern.
Scrophularia marilandica L.
Rorippa palustris (L.) Bess. var. *fernaldiana* (Butters & Abbe) Stuckey
Carex spregnelii Dewey ex Spreng.

curred as scattered shrubs along with the herbaceous species characteristic of this habitat.

At present, agriculture and residential housing fragment these natural habitats. While formerly dominant, *Pinus rigida* now is being displaced by *Pinus strobus, Quercus alba, Q. rubra, Q. coccinea, Acer rubrum* and *Prunus serotina. Quercus ilicifolia* now occurs primarily on roadsides and edges of this successional forest. *Vaccinium angustifolia, V. pallida* and *Gaylussacia baccata* persist as the shrub layer, along with species more commonly found in Mesic or Dry Acidic Oak/Conifer Forest. The following species typical of grassy clearings are now found along roadsides or in clearcuts in the sandplain area: *Quercus prinoides, Carex brevior, Dichanthelium oligosanthes, Schizachyrium* (*Andropogon*) *sco-*

parium, Cyperus filiculmis, Bulbostylis capillaris, Juncus secundus, Rhus copallina, Helianthemum canadense, Hypericum gentianoides, Linaria canadensis, Aster linariifolius and *Krigia virginica.* Species that were listed by Hoffmann (1922) as occasional or common on the sandplain, but have not been re-located since in Berkshire County, include *Helianthemum bicknellii, Lupinus perennis, Crotalaria sagittalis, Asclepias amplexicaulis* and *A. tuberosa.*

These communities are strongly influenced by dry, sandy soil, and are fire dependent. Breakdown of litter is slow because of dryness and low pH of the soil, which results in considerable accumulation of litter, a condition conducive to fire. Fire removes litter, creating conditions that allow sunlight to reach the soil (Henderson, 1982). Bare mineral soil is often necessary for the regeneration of species adapted to fire, such as *Pinus rigida.* However, due to development, incidents of fire are suppressed so that it is unlikely to be a factor in the future. The absence of burning allows conditions conducive to a vegetational change favoring establishment of *Quercus* spp., other hardwoods, and *Pinus strobus,* as noted by Seischab and Bernard (1991) in New York State.

ROCKY SUMMIT AND CLIFF COMMUNITIES

Localities occupied by rocky summit and cliff communities are limited in extent, as exposed rock is rare in this generally mesic region. Acidic bedrock, either gneiss, schist or quartzite, most often is found on summits and ridgetops. In calcareous regions the rock is easily weathered, resulting in few distinct outcrops or vertical cliffs, especially at higher elevations. Differences between the summit and cliff communities may be difficult to define as ridgetops quickly grade into more shaded lower slopes and ledges.

Southern Acidic Rocky Summit Community

Occupying mountain summits and ridges, this community is more common on the southern Taconic summits of the elevation range from 600–792 m, notably Mt. Everett, Mt. Race and Alander Mountain in the southwest portion of the county, on East (533 m) and Monument Mountains (533 m) and on Pine Cobble Mountain (560 m) in the north.

Vegetationally, this community is closely related to the Dry

Acidic Oak/Conifer Forest, but is characterized by larger areas of open bedrock, scattered small trees and dense low shrub growth. *Pinus rigida* is always present, and on the southern Taconic ridges growth of *Quercus ilicifolia* may be very dense. Other trees, such as *Betula papyrifera, Quercus rubra* and *Acer rubrum,* may appear in a rather stunted form. *Juniperus communis* occurs occasionally. The shrub layer is a dense growth of ericaceous shrubs including *Vaccinium angustifolium, Gaylussacia baccata* and *Rhododendron prinophyllum.* On a few southern summits, *Arctostaphylos uva-ursi* occurs in open sunny areas at the edges of outcrops. Other shrubs that grow mixed with these species are *Aronia melanocarpa, Amelanchier stolonifera* and, uncommonly, *Prunus pumila* var. *susquehanae. Potentilla tridentata* appears frequently in openings, as it does on more northern, higher, open ridges.

Diversity of herbaceous species is low: *Woodsia ilvensis* occurs occasionally in southern locations; *Deschampsia flexuosa* and *Schizachyrium scoparium* are common tuft-forming grass species; *Carex pensylvanica* forms extensive patches; *Corydalis sempervirens* is frequent in shallow soil pockets on open rock.

Physiognomy of this community is usually one of extensive low shrubs with few trees. However, an unusual dwarf "forest" of *Pinus rigida,* with *Quercus ilicifolia,* is found on the flat summit of Mt. Everett and on a level ridge in Clarksburg on the southern extension of the Green Mountains; *Quercus ilicifolia* is not present in the latter site. The dwarf trees average about 1 m in height, and present a flat-topped, laterally-growing aspect. Keith (1912) quotes Professor Edward Hitchcock's description of Mt. Everett's summit in 1839: "a naked eminence with numerous yellow pines, two or three feet high." McIntosh (1959) notes a similar dwarf *Pinus rigida* forest on a flat-topped summit in the Shawangunk Mountains of New York.

These summits, unlike most others in the county, have thin soil overlying the schist or quartzite, and what little organic material is there accumulates slowly. There is slight inflow of nutrients, such as might occur on a slope. Conditions are quite xeric, and the lack of a tree canopy allows extremes of heat and dryness to occur. Wind is probably not an important factor in keeping the vegetation low, as there are many higher ridges that are occupied by taller forests; however, fire may be a factor. McVaugh (1958) commented on the possible succession of this community and concluded that it appeared stable. Hoffman (1922) observed the same species that are presently seen, particularly an *Arctostaphylos uva-ursi* population which was known to Dewey (*in* Field, 1829). Areas dominated by *Vaccinium angustifolium* exist on some northern mountain ridges, but these appear to be abandoned pastures that were colonized by *V. angustifolium.* At one time, these areas were burned to maintain the blueberry fields, but they are now being slowly invaded by forest.

Southern Calcareous Rocky Summit Community

Rare throughout the county, usually this community occurs on ridgetops of low hills edging the main valleys, but there are a few high ridges whose rocks, while not true limestone or marble, have a distinct calcareous influence. West Stockbridge and Tom Ball Mountains are good examples.

These open, dry rock outcrops support a vegetation whose species are intolerant of much shade, and require calcareous soil. Many of the plants that are specific for these situations are adapted to growing in crevices with little soil, *Carex eburnea* will often be abundant in such sites. *Clematis occidentalis** is frequent at these sites, while *Trichostema* (*Isanthus*) *brachiatum**, *Minuartia michauxii** and *Lonicera hirsuta** are rare. More northerly elements, rare *Rosa acicularis** growing with *Senecio pauperculus,* occupy a high ridge (532 m) in the northern third of the county. Tom Ball and West Stockbridge Mountains, sharp north-south trending ridges, support a mixture of both lime- and acid-loving species. *Hedyotis longifolia** and *Arabis lyrata** grow with *Woodsia ilvensis,* an acidophile, in crevices on open rock. *Amelanchier sanguinea** forms small patches close to *Gaylussacia baccata, Pinus rigida,* and *Potentilla tridentata. Pinus resinosa,* a native species in Berkshire County, occurs only on these ridges. *Viburnum rafinesquianum** tends to grow in more shaded situations on summits and also on rocky south-facing slopes.

The tendency of trees to uproot and pull away from the steep-sided outcrops maintains the open aspect. Rocks splitting off from sharp ridges also renew open areas, and dry, shallow soil discourages woody growth.

Southern Acidic Cliff Community

Suitable habitat for the establishment of this community is widespread. The vegetation is sparse, and not chacterized by a specific or distinctive group of plants, unlike the Southern Calcareous Cliff Community. *Polypodium virginianum* is always present in crevices and forms large mats on boulders, along with *Aralia hispida, Dryopteris marginalis, Polygonum cilinode, Diervilla lonicera* and *Parthenocissus quinquefolia,* all plants found commonly in acidic situations. Two of the few rare plants found in this habitat are *Asplenium montanum**, which occurs in two localities on quartzite, and *Adlumia fungosa**, found on boulder talus below cliffs.

This habitat is cooler, moister and more shaded than the Summit Community. The acidic rock produces little soil and nutrients for vegetation, and when shaded becomes unfavorable for many species.

Southern Calcareous Cliff Community

This uncommon community is found on steep cliff faces or sloping rock outcrops. Frequently, the ridge is capped with resistant rock while the soft limestone beneath has eroded into ledges and outcrops. The habitat, while found throughout the western part of the county, is best represented in Sheffield, particularly on Bartholomew's Cobble. The vegetation, which includes many of the county's rarer species, is distinct and specific to the habitat. The small ferns, *Pellaea atropurpurea, Asplenium ruta-muraria**, *A. trichomanes, A. platyneuron* and *Woodsia obtusa* colonize sunny or slightly shaded crevices, *Asplenium rhizophyllum* occurs on moss-covered rock faces, while *Selaginella rupestris* and *Campanula rotundifolia* prefer dry, shallow soil pockets on open rock. *Parietaria pensylvanica* colonizes dry to moist rock outcrops; *Arabis lyrata**, *A. laevigata**, *A. hirsuta* and *Saxifraga virginiensis* colonize shaded, moist, deeper pockets of soil, and *Cystopteris bulbifera* and *C. tenuis* are common on moist, shaded calcareous rock. Of the few northern elements, *Cryptogramma stelleri** is found on dripping cliffs and *Woodsia glabella** inhabits shaded crevices in a high, northern cliff.

Few trees or shrubs can grow on these steep rock faces, therefore there is sufficient light and sites for the small species that are adapted for survival on little soil. This diverse community of plants is in contrast to the species poor, sparse vegetation of the Acidic Cliff Community sites.

Serpentine Outcrop Community

There are five or six locations for ultramafic rock in the northeastern part of the county (Figure 1), only two of which occur as exposed outcrops. This bedrock is part of a narrow belt of serpentine rock occurrences along the east flank of the Appalachian Mountains that extends from Alabama to Newfoundland (Zika and Dann, 1985). Serpentine is found as intrusive rock in quartzite, gniess and schist on the Berkshire Plateau.

The sharp contrast between vegetation of serpentine and nonserpentine soils is well-documented (Walker, 1954). This community of serpentine outcrops is characterized as open, with sparse and stunted vegetation, and by the presence of serpentine species, which typically have disjunct distributions, or are even endemic (Zika and Dann, 1985). The outcrops in the county are not large enough to support an extensive serpentine vegetation. *Moehringia macrophylla** is the only taxon on these outcrops that is restricted to serpentine outcrops. *Cerastium arvense* is most abundant on serpentine outcrops, but is also found occasionally in open rocky woods. Other taxa frequent on these serpentine formations include *Asplenium trichomanes* and *Campanula rotundifolia.* The most extensive outcrop, in the town of Florida, also supports other taxa that are considered somewhat calciphilic, such as *Selaginella rupestris* and *Aquilegia canadensis.* In other areas where the slope is not steep, soil may overlie the ultramafic rock, and the vegetation is not notably distinct.

Infertility of serpentine soils is the result of complex factors, and plants endemic to serpentine have developed a variety of adaptations to these conditions. Serpentine rock and its derived soils are high in magnesium, iron and the heavy metals chromium and nickel, but usually deficient in major nutrients such as calcium, nitrogen and phosphorus (Walker, 1954; Brooks, 1987). Lack of organic matter and droughty characteristics of the soil contribute to infertility.

LAKES AND PONDS

These aquatic habitats are classified according to the alkalinity of the water, the most important factor influencing the distribution of species. Hellquist (1980), in his study of the distribution of *Potamogeton* in New England, classified them into six groups, and found that the occurrence of most *Potamogeton* species was strongly correlated with certain ranges of alkalinity. Some species are restricted to a narrow range, but others many tolerate a wide range (Hellquist, 1980). Other aquatics likewise have distributions that correlate with alkalinity of the waters, which is affected by its origin in either acidic or calcareous bedrock. Alkalinity ranges of many aquatics are given in a series of papers on aquatic plants of New England (Crow and Hellquist, 1981, 1982, 1983, 1985; Hellquist and Crow, 1980, 1981, 1982, 1984). Depth of water, bottom conditions, water clarity, velocity of flow and habitat elevation are also important factors that determine species composition of an aquatic habitat.

Clear Softwater Lake/Pond Community

Water bodies with extremely acidic waters occur in regions of acidic bedrock, usually schist or gneiss, at elevations between 448 and 622 m. Most acidic waters occur on the Berkshire Plateau where the poorly-drained, rolling topography has resulted in creation of many lakes and ponds; a few occur on the uplands of the Taconic Range.

Vegetation in general is characterized by submersed species with a rosette growth form and *Potamogeton* spp. that are restricted to very acidic waters. *Isoetes echinospora, Eriocaulon pellucidum* (= *E. septangulare*), *Sagittaria graminea, Elatine minima* and *Lobelia dortmanna* all have a submersed rosette of leaves. *Potamogeton confervoides, P. bicupulatus* and *P. oakesianus* are found only in these extremely acidic waters (Hellquist, 1980). *Potamogeton spirillus* occurs, but is not restricted to the most acidic waters. Floating-leaved components of this community are the common and widespread *Nuphar variegata,* the infrequent *Sparganium fluctuans* and the uncommon *Nymphoides cordata. Myriophyllum tenellum* and *M. humile* may also be present in acidic waters, but their occurrence in the Berkshires is rare.

Acidic bedrock and shallow, rocky basins are important factors in the development of this community. In these waters, alkalinity measurements of up to 18 mg/liter HCO_3^- (Hellquist, 1980) indicate low alkalinity; the pH may be as low as 5.0. The waters are also low in nutrients. Lake and pond bottoms are typically rocky, gravelly or sandy and therefore not suitable for deep-rooted plants. Margins are usually rocky, but may have peat or small areas of sphagnum bog along the edges. Conditions of clear and generally shallow water are conducive to growth of rosette-leaved plants. South Pond in Savoy State Forest has an excellent examples of this community.

Acidic Brownwater Lake/Pond Community

Like the preceding habitat, this community is found at the higher elevations in regions of acidic bedrock on the Berkshire Plateau. It is usually associated with bog habitats, or boggy areas that may have been altered or flooded.

The vegetation includes more species of the floating-leaved form, such as *Nuphar variegata, Nymphaea odorata, Brasenia shreberi, Sparganium fluctuans, S. angustifolium* and the rare *Nuphar pumila**. *Utricularia radiata* is quite common on the Plateau along with *U. vulgaris,* a widespread species present in a variety of habitats. *Utricularia purpurea* may occur in both the Clearwater and Brownwater habitats, while *U. geminiscapa* is more restricted to bog waters. *Potamogeton epihydrus* var. *ramosus* is fairly common in this habitat. *Eriocaulon pellucidum* and *Sagittaria graminea* occur in shallow waters at the margins.

Ecological factors here are similar to those of clearwater habitats, but depth of water, light penetration, and substrate differ. Alkalinity levels may range up to 30 mg/liter HCO_3^- (Hellquist, 1980). If the basin of the water body is deep, organic matter will accumulate and provide suitable substrate for deep-rooted aquatics. The water becomes discolored with accumulated dissolved organic acids and fine particles of organic matter, which reduce the amount of sunlight available for growth of plants of a submersed growth form (McVaugh, 1958). Lack of drainage also contributes to increased organic accumulation. Bog Pond in Savoy State Forest and the Spectacle Ponds in Sandisfield State Forest are good examples of this aquatic community.

Moderately Alkaline Lake/Pond Community

The aquatic community of this and the following type are found in regions with calcareous bedrock in the Central Valley Region and occur at elevational range of 221–391 m.

Potamogeton species that more often occur within an alkalinity range of 18–73 mg/liter HCO_3^- include *Potamogeton spirillus, P. epihydrus* var. *ramosus* and *P. robbinsii,* which also inhabit less alkaline waters (Hellquist, 1980). *Potamogeton amplifolius, P. gramineus, P. natans, P. praelongus, P. obtusifolius, P. zosteriformis* and *P. epihydrus* var. *epihydrus* are found in progressively more alkaline waters. The pH of these waters ranges from 7.0 to 9.0. Other aquatics that occur in moderately alkaline waters are *Cerotophyllum demersum, Najas flexilis, Elodea canadensis,* and occasionally *E. nuttallii, Vallisneria americana* and *Ranunculus longirostris. Lemna trisulca* is found more often in alkaline situations, while *L. minor* and *Spirodela polyrhiza* are common and widespread in most water. *Nuphar variegatum* and *Nymphaea odorata* are commonly found here also, *Myriophyllum sibiricum* (= *M. exalbescens*) is occasional, and the adventive *M. spicatum* can become a troublesome weed.

The higher alkalinity of the water, which derives from streams and springs flowing through calcareous bedrock, is the most important factor in this community; edaphic factors are important also. Situated mainly in the valleys, where till, outwash or alluvial soil is abundant and more or less alkaline, ponds and lakes have accumulated thick layers of muck on the bottom. Examples of this habitat are Lake Garfield, which is less alkaline. Lakes Pontoosuc and Onota in Pittsfield, and Prospect Lake in Egremont have higher, yet moderate alkalinity levels.

Highly Alkaline Lake/Pond Community

This rich and diverse aquatic community is similar in most respects to the preceding one and shares most of the vegetational elements. The alkalinity levels range from 73 to more than 109 mg/liter HCO_3^- (Hellquist, 1980). The pH may range up to 10.7. This community is distinguished by several *Potamogeton* species that are more typically found in these waters. *Potamogeton pusillus* var. *pusillus, P. foliosus* and *P. illinoensis* are common, while *P. friesii** is very rare. The alien *Potamogeton crispus* inhabits nutrient-enriched, sometimes polluted waters. *Potamogeton nodosus* may be present, but is more often found in quiet sections of rivers and streams. *Potamogeton pectinatus* is restricted to the most alkaline waters, those with levels above 109 mg/liter HCO_3^- (Hellquist, 1980). The same is true of *P. hillii**, which has the greatest concentration of populations, world-wide, in Berkshire

County (Hellquist, 1984), and is frequent locally in cool waters of beaver ponds and small streams. *Heteranthera dubia* is common in many highly alkaline sites while *Megalodonta beckii,* which is fairly uncommon, also occurs in this habitat, at least in Berkshire County. Often plants in these waters are encrusted with marly deposits. Good examples of highly alkaline water bodies are Shaker Mill and Cranberry Ponds in West Stockbridge, Lake Buel in Monterey and Mill Pond in Egremont.

RIVERS, STREAMS AND SPRINGS

Rivers and streams may be characterized as high-, medium- or low-gradient, depending on steepness of slope; most have stretches of both fast and slow-moving waters. Rapid sections are often at the headwaters, which originate on the slopes of mountains and on the Berkshire Plateau. In the valleys, streams typically meander, and are bordered by wide floodplains. Vegetation of both the waters and immediate banks is discussed here.

High-gradient Stream Community

There is no distinctive vascular aquatic vegetation in these streams. Usually the riverbank vegetation reflects the surrounding forest type, but may tend to have more mesic species. *Carex torta* is commonly found among rocks along the shore. A few elements of a flood-scoured bedrock community, as described by Rawinski (1986), occur along the Deerfield River, such as *Sanguisorba canadensis, Aster johannensis, Andropogon gerardii, Rosa blanda* and *Trisetum triflorum* ssp. *molle.*

Medium-gradient Stream Community

These rocky or gravelly streams, which are typically quite shallow, also contain few distinctive vascular aquatic plants. *Callitriche heterophylla* often colonizes sites in the shallow, quieter waters of these streams, and a few floodplain tree species, such as *Platanus occidentalis* and *Salix nigra,* may occur on streambanks. *Lobelia cardinalis, Helenium autumnale* and *Rudbeckia laciniata* seem to be generally restricted to streambanks, while numerous gravel bars support a few weedy species.

Low-gradient Stream Community

The aquatic flora of deep, slow-moving waters, with alluvial banks and silty bottoms, is similar to that of the Moderately and Highly Alkaline Lake/Pond Communities, but fewer species are present. The Housatonic watershed has the highest alkalinity of any in New England (Hellquist, 1980). The Hoosic River and its tributaries, which are part of the Hudson River watershed, has the third highest alkalinity in New England. *Potamogeton epihydrus* var. *ramosus* and *P. amplifolius* inhabit less alkaline streams, while *P. nodosus, P. hillii** and *P. perfoliatus* occur in highly alkaline streams. The introduced *P. crispus* is common in more polluted streams. *Ceratophyllum demersum* and *Elodea canadensis* occur in shallow backwaters, while *Myriophyllum spicatum* tends to be found in deeper water. Shallow, muddy waters may be colonized by *Sparganium americanum* and *S. emersum,* both of which often exhibit long, ribbon-like floating leaves in faster moving currents, while becoming emergent and reproductive nearby on the stream margin.

The silt banks and bars associated with this stream type host a distinctive pioneer community limited to annuals, due to the instability of these bars. Commonly found species are *Lindernia dubia, Bidens cernua, Xanthium strumarium, Eragrostis pectinacea, E. hypnoides, Rorippa palustris* and *Cyperus aristatus*; less common are *Gratiola neglecta, Veronica anagallis-aquatica,* and the rare grass *Eragrostis frankii**.

Spring and Spring Run Community

This community is found throughout the county wherever water wells up as springs and forms small streams. Shaded springs have little vegetation. However, the adventive *Nasturtium officinale,* and native species such as *Veronica americana, Chrysosplenium americanum* and *Mentha arvensis,* are typically abundant in springs of sunny locations and along spring-fed streams.

WETLANDS

There is a great variety of wetlands in Berkshire County, ranging from forested swamps to open graminoid wet meadows and level bogs. Many elements of these communities have a considerable latitude of occurrence. A community may contain elements of both acidic and calcareous associations; one community may grade into another as a series of vegetation zones. For example, a Forested Fen may surround a Lake Basin Graminoid Fen, with Shrub Fen elements extending into both communities. Or, very commonly, there may be a mosaic of communities occurring in small patches throughout a wetland area.

Important in influencing the occurrence of these communities is the degree of acidity or alkalinity of the water, which is influenced by its source, the underlying bedrock, and the soil type. Soil depth and amount of accumulated organic matter also significantly influences the type of vegetation. Drainage through the wetland, whether very little, as in bogs, or considerable, as in swamps, marshes and fens, is an important factor affecting the amount of organic accumulation and nutrient supply (Dansereau and Segadas-Vianna, 1952).

In the following discussion, swamps include both forested wetlands and shrub swamps; marshes are open wetlands dominated by emergent or graminoid species; bogs and fens are treated separately.

SWAMPS

Acidic Conifer Swamp Community

These swamps occur on the Berkshire Plateau (420–600 m elevation) on flats adjacent to bogs or streams. The dominant species are *Abies balsamea* and *Picea rubens,* or *Picea mariana*; *Tsuga canadensis* is also common. The ground is typically covered with a deep layer of *Sphagnum* spp. and other mosses; shrubs and herbaceous plants are sparse. Among the shrub species are *Nemopanthus mucronata* and *Ilex laevigata.* The small evergreen groundcover taxa include *Gaultheria hispidula, Linnaea borealis,* and *Coptis trifolia. Cornus canadensis, Carex disperma, C. echinata, C. folliculata* and *C. trisperma* are common on the mossy mat; *Smilacina trifolia* is occasional.

Although the soil surface is peaty, often there is little accumulation, and the mineral soil layer is typically thin and rocky, unless the forest has developed over the margin of an old bog. Pools of standing water occur between roots and in low places. Poor drainage, coupled with acidic bedrock, are factors that contribute to the low nutrient condition of the soil. Wolf Swamp in New Marlboro is an example of a closed bog with a well-developed Acidic Conifer Swamp along the edge.

Acidic Hardwood Swamp Community

This community, often referred to as the Red Maple Swamp Community, is frequent in the county at lower elevations in poorly-drained acidic sites. It is dominated by *Acer rubrum,* which although abundant, does not typically develop into large trees as in mesic terrestrial sites. Other tree species include *Ulmus americana,* and usually *Pinus strobus* on the drier margins. *Quercus bicolor* and *Nyssa sylvatica* may occur in this community, but only in the extreme southern part of the county.

The forest canopy is somewhat open, and a variety of shrubs and herbaceous species are associated with this community. Typical shrubs include *Ilex verticillata, Viburnum lentago, V. cassinoides* and *Lyonia ligustrina,* and occasionally *Nemopanthus mucronata. Salix discolor* and *S. sericea* may occur in openings. Common herbaceous species include *Osmunda regalis, O. cinnamomea, Dryopteris cristata, Onoclea sensibilis* and *Carex stricta.*

Important factors influencing this community are acidic water, derived from acidic substrate, poor drainage, and nutrient-poor soils. Few tree species can tolerate both high water levels and low nutrient conditions. Tree species, such as *Acer rubrum* and *Pinus strobus,* which need sunny openings to regenerate, are well-adapted to this habitat and find little competition here. Although quite acidic, there is no accumulation of peat in this habitat.

Circumneutral Hardwood Swamp Community

Given the extensive calcareous deposits in Berkshire County, this community and other more calcareous ones are common throughout the county, except on the Berkshire Plateau. These swamps may occur along rivers or streams or at headwater sources of a stream.

The dominant trees are *Fraxinus nigra* and *Acer rubrum,* and occasionally *Quercus bicolor* in the extreme southern portion of the county. The understory tree *Carpinus caroliniana* is common while *Lindera benzoin* is usually the dominant shrub. Of the herbaceous plants, the most typical are *Symplocarpus foetidus, Saxifraga pensylvanica, Veratrum viride, Solidago patula, Equisetum sylvaticum, Osmunda cinnamomea, Carex bromoides, Rubus pubescens* and *Platanthera psycodes.*

Important factors influencing the community are rate of flow and pH of the water. In this community, ground water approximating a neutral pH seeps to the surface and flows slowly toward a stream, constantly supplying nutrients to the plants and creating a seepage swamp (McVaugh, 1958). Levels of alkalinity higher than preceding wetland communities facilitate nutrient uptake and decomposition of organic material.

Acidic Shrub Swamp Community

This community is widespread in regions where waters and soils are acidic, thus is more extensive on the Berkshire Plateau; it occurs on margins of streams and in poorly-drained basins. The dominant species is usually *Alnus incana* ssp. *rugosa,* but a number of other shrubs occur, including *Ilex verticillata, Spiraea latifolia, Vaccinium corymbosum, Cephalanthus occidentalis, Myrica gale, Lyonia ligustrina, Viburnum cassinoides* and *V. recognitum.* A few tree species such as saplings of *Acer rubrum,* or, if on the Berkshire Plateau, *Abies balsamea* or *Picea rubens,* are usually present, as well as the small tree *Amelanchier arborea* and the vine *Clematis virginiana.* Herbaceous species include *Onoclea sensibilis, Osmunda cinnamomea, O. regalis, Glyceria striata, Carex gynandra* and *C. stricta.* Additionally, *Aster puniceus* and *Eupatorium maculatum* occur in openings.

This habitat is similar to that of the Acidic Hardwood Swamp; shrub swamps may be transitional to a forested type. Flooding or water level fluctuation may retard or reverse the tendency toward development of a swamp forest.

Circumneutral Shrub Swamp Community

This community typically occurs on the low margins of streams or ponds, where the alkalinity of the water is nearly neutral. It is widespread in the county, but is more common in the valley region. Dominant shrubs are *Cornus amomum, C. stolonifera, Salix discolor, S. sericea* and *S. eriocephala. Lindera benzoin* is important as a good indicator of less acid conditions, and tends to be more abundant when slightly shaded, unlike the previously-named shrubs. *Rosa palustris* grows thickly along marsh edges, *Alnus incana* ssp. *rugosa* is present, but plants tend to be scattered, and the vines *Clematis virginiana* and *Solanum dulcamara* can be abundant. Among the herbaceous species, *Symplocarpus foetidus, Saxifraga pensylvanica* and *Solidago patula* are most distinctive of the community. Other common species are *Osmunda cinnamomea, Dryopteris cristata, Viola obliqua, Caltha palustris, Ranunculus hispidus* var. *caricetorum, Carex lacustris* and *Glyceria grandis.* Tree species, such as *Ulmus americana* and *Acer rubrum* may also occur.

As in other wetland communities, alkalinity of water and topography are the main factors affecting the composition of this community. The habitat is similar to that of Circumneutral Hardwood Swamp. This community may be successional, as described by McVaugh (1958), but extremely wet or flooded conditions, such as those caused by beavers, may preclude extensive tree growth, or even kill existing trees.

MARSHES

The vegetation of marshes is characterized by tall, emergent graminoid species and some broad-leaved species growing either in water or in saturated soil. There is adequate movement and drainage of water to supply nutrients and remove organic acids. The soil is a mixture of organic and mineral sediments (Dansereau and Segadas-Vianna, 1952).

Robust Emergent Marsh Community

This community is found in shallow water along streams, rivers, ponds and lakes throughout the county. It is dominated by tall emergents that are rooted in a thick layer of organic muck or deeper mineral soil. Waters and soil may vary from acidic to fairly alkaline, with the most common condition being intermediate, making it difficult to delineate two separate communities.

Typha latifolia is most common and typically present in most marshes. *Typha angustifolia* occurs in more alkaline sites or along roadsides experiencing significant salt runoff from winter road salting. Other common species more often seen in acidic marshes are *Scirpus cyperinus, S. pungens, Sparganium americanum, Eleocharis smallii, Spiraea latifolia, S. tomentosa* and *Aster puniceus.* With increasing alkalinity, *Scirpus tabernaemontanii* (= *S. validus*), *S. acutus, Sagittaria latifolia, Pontederia cordata, Peltandra virginica, Alisma subcordatum, Equisetum fluviatile, Potentilla palustris, Sium suave, Cicuta bulbifera, Carex comosa, C. lacustris, Asclepias incarnata, Iris versicolor* and *Lysimachia terrestris* will be observed, along with the preceding species. *Acorus calamus* and *Sparganium eurycarpum* occur in the more alkaline habitats, as does *Sagittaria cuneata**, which is found only in occasionally flooded oxbow ponds.

Depth and flow of water, and to a lesser extent the acidity or alkalinity of the water and substrate, as well as depth and texture of the substrate, are important factors influencing this community. Maximum depth of water for *Scirpus cyperinus* is approximately 50 cm (Kadlec, 1958), for *Typha latifolia,* approximately 60 cm (Grace and Wetzel, 1981). Higher alkalinity increases organic decomposition and nutrient availability. A slow water-flow allows accumulation of mineral and organic soil favoring growth of rhizomes and roots of these and other species associated with this community.

Acidic Graminoid Marsh Community

This community, associated with rivers, streams and ponds, becomes established in very moist to saturated soil that is usually above water level in the latter part of the growing season. It occurs more often in the poorly-drained areas of the Berkshire Plateau, where broad, shallow margins of acidic ponds and streams provide much of this habitat type.

The vegetation is dominated by a variety of grasses and sedges, the most typical being *Calamagrostis canadensis, Glyceria canadensis, Carex stricta, C. folliculata, C. lurida, Dulichium arundinaceum, Scirpus cyperinus* and *S. atrocinctus.* Other common species are *Triadenum virginicum, Juncus canadensis, J. brevicaudatus* and *Eupatorium perfoliatum.* Smaller species that may exist in openings are *Eleocharis obtusa, Hypericum boreale, Lycopus uniflorus* and *Gratiola neglecta.*

Flat stream valleys with acidic bedrock, acidic waters and infertile soils contribute to the formation of this vegetation type.

Many of these marshes develop from silted-in, abandoned beaver ponds.

Circumneutral Graminoid Marsh Community

This community, more often found along streams and rivers in the valley region where substrate and water tend to be more alkaline, is more diverse than that of the previous community, with a greater variety of sedges and forbs.

The common grasses include *Calamagrostis canadensis, Phalaris arundinacea, Glyceria grandis, G. borealis* and *Leersia oryzoides.* Common sedges are *Carex lacustris, C. stipata, C. vulpinoidea* and *C. comosa,* as well as the rarer *C. trichodcarpa**, common only in Hoosic River swales. *Eleocharis intermedia** may occur on open mud margins. *Iris versicolor* and *Angelica atropurpurea* are common in this, and many other, wetland types. *Acorus calamus* and *Juncus nodosus* occur in nutrient-rich sites. Many smaller forbs occur between the graminoids or at marsh edges, such as *Thelypteris palustris, Boehmeria cylindrica, Scutellaria galericulata, Campanula aparinoides, Penthorum sedoides, Verbena hastata, Mimulus ringens, Lysimachia thyrsiflora, Asclepias incarnata* and *Solidago uliginosa.*

Water and soil of circumneutral alkalinity, topography and development of thick swamp muck, are important factors influencing the distribution of the community.

BOGS

Level Bog Community

The acidic bog is a well-defined, often-studied community distinguished by a floating *Sphagnum* mat and dominated by ericaceous shrubs. This ombrotrophic peatland is most often found on the Berkshire Plateau in poorly-drained basins associated with acidic bedrock at elevations averaging 520 m. At least one bog occurs in a sandy outwash underlain by clay at an elevation of 213 m in Sheffield (Oltsch, 1974).

The vegetation may occur in a regular series of zones from an open water pond in the center to a forested zone at the edge of the bog (Crow, 1969). When lacking an extensive *Sphagnum* mat, elements of these zones may be clustered in an irregular pattern around the outer edge. The species composition of these zones varies from one bog to another, but certain species are almost always present. *Chamaedaphne calyculata* and *Decodon verticillata* are common at the inner edge along the pond edge, their intertwined stems and roots forming a base for the beginning of a *Sphagnum* mat. If there is a broad *Sphagnum* mat, sedges such as *Carex limosa, C. paupercula, C. canescens* and *C. lasiocarpa* occur along with *Eriophorum virginicum, E. tenellum, E. vaginatum, Cladium mariscoides* and *Scheuchzeria palustris**. Other species common on the mat are *Vaccinium macrocarpon, V. oxycoccos, Sarracenia purpurea, Rhynchospora alba* and *Drosera rotundifolia. Pogonia ophioglossoides* is fairly common, while *Calopogon tuberosus* and *Platanthera blephariglottis* are less so. In open, peaty, shallow pools, *Xyris montana, Drosera intermedia, Utricularia cornuta,* and occasionally *U. gibba* occur. *Picea mariana* and *Larix laricina* occur as scattered, stunted trees, and in small clumps on the mat, but become denser and taller at the outer bog edge. The bog heaths, *Andromeda glaucophylla, Kalmia polifolia* and *Ledum groenlandicum* may form a large shrub zone nearer to the outer edge along with *Myrica gale. Calla palustris* commonly grows in *Sphagnum* among the heaths, while *Smilacina trifolia* occurs occasionally. There may be an abrupt change to upland woods, or bog shrubs may give way gradually to swampy coniferous woods; a moat may also occur at the outer edge.

Several factors affect formation of the typical level bog, including acidity, nutrients, water flow, basin depth, and climate. Ombrotrophic bogs have little inflow or outflow, and are dependent on rainfall for the few nutrients that enter the system (Heinselman, 1963). Berkshire bogs range from those with absolutely no inflow to those fed by small streams from a limited watershed. Lack of drainage leads to accumulated organic acids that retard decomposition of organic material (Dansereau and Segadas-Vianna, 1952). *Sphagnum* moss actively produces acidic conditions (Andrus, 1980), and strongly influences the vegetation patterns.

Characteristic of cold basins, temperature measurements taken in a Massachusetts bog (542 m elevation) by Moizuk and Livingston (1966) showed that the bog mat experienced approximately one-third the number of frost-free days as was recorded in the surrounding forest. They also determined that nutrient deficiencies hindered *Acer rubrum* from invading the mat. Those conditions, and the instability of the bog mat, may retard or prevent succession to a closed bog forest. Larsen (1982) indicates that succession may take an irregular course, which can be reversed, or can diverge toward a variety of associations.

FENS

Fens differ from bogs in several ways. Cold water, seeping up through calcareous bedrock, becomes highly alkaline and moves slowly through the community toward a small stream (Schwintzer, 1978, 1981). High levels of minerals are constantly supplied. A floating mat may develop, but it will be dominated by sedges and grasses. *Sphagnum* is typically absent, but may appear as small patches and hummocks, accompanied by other bog vegetation. There are a variety of fen community types, ranging from those that are peatland communities to those lacking peat, and they may exist as a mosaic or in definite vegetation zones. The species composition of fens is rich and diverse, containing many plants rare for the state. A preponderance of fen communities in Massachusetts is found in southern Berkshire County, because of its extensive calcareous bedrock and more level terrain.

Forested Fen Community

Influenced by highly calcareous water, this peatland community is found more frequently in the southern half of the county, and is usually associated with other fen communities. These fens tend to occupy edges of level basins or margins of extensive, flat areas along gently flowing streams in open valley bottoms.

Species composition of the tree layers shows considerable variation from site to site, there being both hardwood and conifer elements that are important. *Larix laricina* is the dominant conifer, and in the valley region it seems to be an indicator of fen conditions. *Fraxinus nigra* is always present, and *Acer rubrum* commonly occurs as well. *Quercus macrocarpa** is common in the southern part of the county. In some fens *Tsuga canadensis* is one of the dominant trees. *Thuja occidentalis**, while never common, is very rare at present, possibly because it was thoroughly harvested in earlier times.

In forested fens, trees are typically scattered, thus the canopy is usually open. Fen shrubs such as *Salix candida* and *S. serissima, Rhamnus alnifolia* and *Potentilla fruticosa* occur in open areas.

These species are good indicators of highly calcareous situations. *Ribes triste** occurs in shaded wet areas. Shrubs typical of acidic bogs such as *Andromeda glaucophylla* and *Ledum groenlandicum* occur only on *Sphagnum* hummocks raised above, and isolated from, the calcareous water. In muddy, bare openings, small herbaceous species such as *Lobelia kalmii,* and rarities such as *Malaxis brachypoda** and *Rhynchospora capillacea** occur. Other species associated with Forested Fens are *Cypripedium calceolus* var. *parviflorum**, *C. reginae**, *Pyrola asarifolia**, *Conioselinum chinense** and very rarely *Petasites frigidus* var. *palmatus**.

The presence of a number of northern species found in fens may be due to the cold groundwater, which has provided a stable, cool habitat. Fens along Schenob Brook in Sheffield are among the most extensive and significant.

Shrub Fen Community

This community is found in association with other peatland fen communities, either intermixed or as a zone at the edge. The dominant and characteristic shrubs are *Salix candida, S. serissima** and *Potentilla fruticosa,* an important indicator plant of any calcareous situation, wet or dry. The small shrub *Rhamnus alnifolia* is also a reliable indicator of fen conditions; other common shrubs are *Toxicodendron vernix* and *Ribes hirtellum. Lonicera villosa* occurs most often in association with fens. The small tree *Betula pumila** occurs at the edge of shrub fens and in open graminoid fens, along with small specimens of *Larix laricina.* The shrub layer has many openings where herbaceous species such as *Geum rivale, Lysimachia thyrsiflora, Galium labradoricum**, *Solidago patula, Cirsium muticum, Symplocarpus foetidus* and *Carex interior* occur. *Carex castanea**, a rare northern species, occurs at edges of shrub fens.

Sloping Graminoid Fen Community

This peatland community, often referred to as a calcareous wet meadow, occurs in calcareous areas throughout the central valley region of the county, but more often in the southern two-thirds, and is found on the sloping edge of other fen communities. Many of its species, restricted to this community, are rare in the state.

Sedges dominate this community, with the common species being *Carex flava, C. granularis, C. lanuginosa* and *C. aurea.* Rare species include *Carex alopecoidea**, *C. chordorrhiza**, *C. sterilis** and *C. tetanica**. *Scirpus pendulus** may be locally abundant in these rich meadows. The most common cotton-grass is *Eriophorum viridicarinatum*; less common is *E. gracile**. *Muhlenbergia glomerata* is typical of these fens. The rare *Cardamine pratensis* var. *palustris** occurs in small pools between sedge tussocks. Other indicative herbaceous species are *Geum rivale, Galium boreale**, *Lobelia kalmii, Parnassia glauca, Gentianopsis crinita* and *Solidago purshii.* Both *Liparis loeselii* and *Sisyrinchium mucronatum** are restricted to, yet uncommon in, this community. Usually, small individuals of the shrub fen are also present here, such as *Rhamnus alnifolia, Salix candida* and *S. serissima* and saplings of *Larix laricina,* indicating that without some form of disturbance, shrub fen elements would become more common. Many of these sloping fens are presently maintained as pastureland or by mowing at various times.

Lake Basin Graminoid Fen Community

This rare community occurs on extensive, flat, former lake basins that have become filled with peat, and is influenced by highly alkaline water from both ground water and adjacent small streams. Elements of the sloping graminoid fen, the shrub fen and forested fen communities surround the open, flat sedge-dominated mat. Bog elements are also present. The open flats adjacent to pond and stream are dominated by *Carex aquatilis* and *C. lasiocarpa,* typical of minerotrophic fens (Schwintzer, 1978; Larsen, 1982). *Scirpus acutus* and *Cladium mariscoides* occur at the pond edge. *Typha latifolia* occurs scattered throughout the sedge flats. Small, open, muddy sites contain *Eriophorum alpinum* (= *Scirpus hudsonianus*) and a rare, northern species, *Eleocharis pauciflora**. *Utricularia intermedia* occurs in shallow channels. The shrub *Myrica gale* is also present. Shrubs typical of fens, such as *Salix pedicellaris, S. candida* and *Potentilla fruticosa* occur scattered, while *Betula pumila** is part of the shrub fen that borders the sedge flat. Bog species, such as *Calopogon tuberosus, Pogonia ophioglossoides, Sarracenia purpurea, Andromeda glaucophylla, Carex limosa* and *Vaccinium macrocarpon* occur in scattered patches of *Sphagnum.* The one excellent example of this community in the county is Kampoosa Fen in Stockbridge, from which this description is drawn.

The broad basin topography allows the accumulation of a large expanse of peat, enabling the community to form an extensive and fairly uniform association. The resulting flat topography may not be as well drained as in other fen systems, and areas that are more remote from water flow may develop accumulations of *Sphagnum* and other acidophilic bog species (Larsen, 1982; Schwintzer, 1981).

Calcareous Seep Community

This is a small, unusual and distinctive community found throughout the county where cold, calcareous water seeps to the surface and forms small rivulets that, at times, flow just under the soil surface. It usually occurs on slopes in rocky or gravelly soil; no peat accumulates.

The vegetation consists mainly of sedges and other low graminoids and herbaceous species. *Parnassia glauca* is an indicator plant. *Equisetum hyemale* or *E. variegatum* often forms dense, pure stands; *E. scirpoides** occurs on cool, moist, mossy surfaces. Various species characteristic of other fen communities are also present here, such as *Carex aurea, C. granularis, C. leptalea, Muhlenbergia glomerata, Malaxis brachypoda*, Cypripedium reginae*, Spiranthes cernua, S. romanzoffiana*, Lobelia kalmii* and *Petasites frigidus* var. *palmatus**.

The slope and flowing ground water create an unstable situation where trees seldom persist beyond the sapling stage, therefore perpetuating the sunny openings that can be colonized by small fen species requiring at least some sun. *Cypripedium reginae**, for example, may be shaded out in forested fen habitats, while in this community, it may persist indefinitely.

SUMMARY

The floristic diversity of the county is illustrated by the recognition of 35 major plant communities. Of primary importance influencing the development of these diverse communities are the underlying bedrock and the topographical heterogeneity of the county, climate, local microclimatic conditions, groundwater pH and alkalinity, and soil nutrient levels. Important also is the diversity of the pool of species available to colonize these habitats, and the post-glacial history of plant migrations into New England.

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